Title: The Solar Powered Racer Challenge

Brief Overview:

The students will develop plans for and construct a vehicle powered by a solar cell using only the materials provided which will travel the length of a lighted track in the fastest time possible.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  The use of mathematics in the design, construction and testing of the prototype vehicle.

- **Mathematics as Communication**
  The students will use technical drawing practices to develop the design of the prototype and written evaluations to describe it's performance.

- **Mathematics as Reasoning**
  Based on written performances of the class, students will use graphs to determine the best design elements to include in the building of a solar powered vehicle.

- **Mathematical Connections**
  Students will utilize scientific principles of potential and kinetic energy, simple machines and basic engineering practices in combination with related mathematical formulas to develop the design of the prototype vehicle.

- **Algebra**
  The students will utilize formulas and equations to calculate the actual speed of the vehicle and the scale speed of the vehicle.

- **Measurement**
  The students will reinforce basic measurement skills as well as scale measuring in the design and evaluation steps of the design process.

Grade/Level:

Grades 6 through 8.

Duration/Length:

Six to eight 45-minute class periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Basic measurements
- Basic arithmetical skills; simple addition, subtraction, multiplication, division
- Utilization of common fractions

Objectives:

Students will:

- develop an understanding of the utilization of the systems model for problem solving.
- apply basic mathematical skill in combination with science concepts to develop solutions to a given problem.
- compare results of prototype testing and utilizing mathematical concepts project results from the model to real-life conditions.
- develop a basic understanding of the construction and utilization of various types of solar energy collection devices.
- demonstrate their ability to apply knowledge of mathematical and scientific concepts to solve a given problem.

Materials/Resources/Printed Materials:

- Solar racer kit
- Graph paper
- Low temperature hot glue guns and glue sticks
- Utility knives
- Solder irons
- Solar track ..(flood lights to provide light power)

Development/Procedures:

Using the materials provided in the solar racer kits, each student will design a vehicle that will travel the length of the lighted track powered by only the solar panel and motor provided.

- Discuss the design process with students.
- Discuss the systems approach to problem solving with the students.
- Identify the problem and it's limitations.
- Identify any key design factors.
- Discuss the basic propulsion methods; gears, pulleys, and propeller.
- Discuss the principles of torque and gear ratio as it applies to the problem.
- Allow students to brainstorm designs and choose a final design to develop fully.
- Have students construct the vehicle with the given material provided in the kits.
- Have students test each vehicle after construction.
- Have students calculate the speed of the vehicle in miles per hour based upon timing the vehicle over a distance of ten feet.
- Using the wheel bases of the prototype and of an average midsize car, have students project the speed of the prototype if it were full size (calculate scale speed).
- Have students compare different design features and performance results of the classes prototypes and identify those features that should provide optimum performance using a graph developed by the students.

Performance Assessment:

A rubric can be developed to include the design of the vehicle, construction, and overall performance of the student's prototype and knowledge and application of the mathematical and scientific concepts. e.g., scores from 4 to 1 in each area. See attached score sheet.

Extension/Follow Up:

Students could design and construct a second prototype based upon the data collected as a result of the previous testings to determine if their theory of prototype improvement is valid.

Authors:

Roger P. Collins
Middletown High School
Frederick County, MD

Barry Segal
CMST
Laurel, MD

Vehicle Design	4 Sketches, and drawings are accurate, specific and fully developed.	3 Sketches, and drawings are accurate, specific and mostly developed.	2 Sketches and drawings are somewhat accurate and specific.	1 Sketches and drawings are inaccurate and underdeveloped.
Vehicle Construction	4 Vehicle is constructed according to all required specifications and the developed plans.	3 Vehicle is constructed according to most required specifications and the developed plans.	2 Vehicle is constructed according to few required specifications and the developed plans.	1 Vehicle is not constructed according to required specifications and the developed plans.
Overall Performance	4 Vehicle performed well according to plans and specifications.	3 Vehicle performed mostly according to plans and specifications.	2 Vehicle performed somewhat according to plans and specifications.	1 Vehicle did not perform according to plans and specifications.